A THEORY OF COUNTERCYCLICAL GOVERNMENT MULTIPLIER

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American Economic Journal: Macroeconomics, 2014

GOVERNMENT MULTIPLIER IS COUNTERCYCLICAL

- US evidence:
  - Auerbach & Gorodnichenko [2012]
  - Candelon & Lieb [2013]
  - Fazzari, Morley, & Panovska [2015]
- international evidence:
  - Auerbach & Gorodnichenko [2013]
  - Jorda & Taylor [2016]
  - Holden & Sparrman [2018]

EXISTING EXPLANATION: ZERO LOWER BOUND

- multiplier is large in bad times because of the zero lower bound
  - Eggertsson [2011]
  - Christiano, Eichenbaum, & Rebelo [2011]
  - Eggertsson & Krugman [2012]
- but evidence of countercyclical multipliers is obtained away from the zero lower bound

THIS PAPER'S EXPLANATION: LABOR MARKET SLACK

- multiplier $\equiv$ additional number of employed workers when 1 worker is hired in the public sector
- multiplier doubles when unemployment rises from 5% to 8%
  - irrespective of the zero lower bound
- mechanism based on the matching model of the labor market from Michaillat [2012]
  - unemployment = rationing + frictional

IMPORTANCE OF PUBLIC EMPLOYMENT

- public employment = 63% of government consumption expenditures in the US, 1947–2011
  - even more if purchase of services (contractors) are included
- stimulus packages often raise public employment
  - Great Depression [Neumann, Fishback, & Kantor 2010]

MECHANISM: CROWDING OUT

- public employment crowds out private employment
  - because government and firms compete for the same jobseekers
- formally: an increase in public employment raises labor market tightness
  - $\rightsquigarrow$ raises recruiting costs
  - $\rightsquigarrow$ reduces private employment

MECHANISM: BAD TIMES VS. GOOD TIMES

- bad times: labor demand is low so unemployment is high and competition for workers is weak
  - ⇝ weak crowding out
- good times: labor demand is high so unemployment is low and competition for workers is strong
  - ⇝ strong crowding out
- procyclical crowding out ⇝ countercyclical multiplier

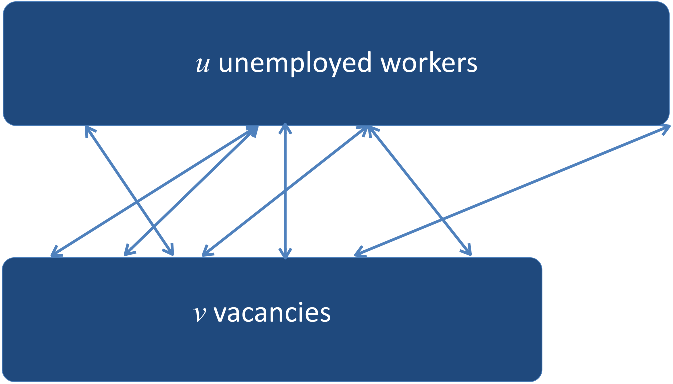
MATCHING MODEL

WITH PUBLIC EMPLOYMENT

PUBLIC EMPLOYMENT

- the government employs g_t workers
  - public employment is financed by an income tax
- public and private jobs are identical
  - same wage w
  - same job-separation rate s
- unemployed workers indiscriminately apply to public and private jobs
- public and private vacancies compete for the same unemployed workers

MATCHING FUNCTION



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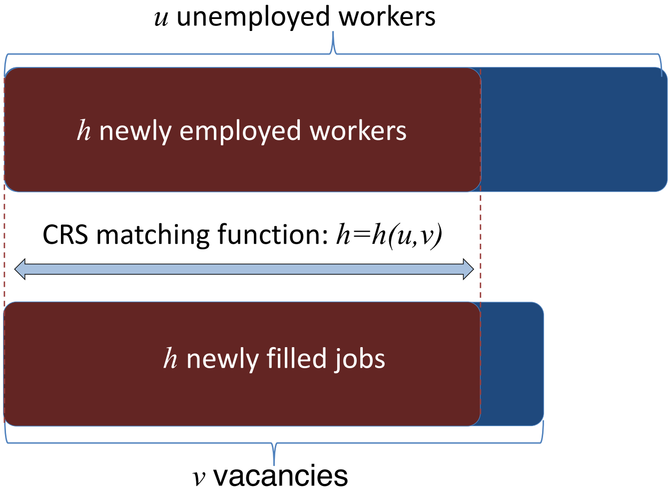


MATCHING FUNCTION

tightness: $\theta = v\,/\,u$

u unemployed workers

job-finding probability:

$$f(\underset{+}{\theta}) = h/u = m \cdot \theta^{1-\eta}$$

$$h = m \cdot u^{\eta} \cdot v^{1-\eta}$$

vacancy-filling probability:

$$q(\underset{-}{\theta}) = h/v = m \cdot \theta^{-\eta}$$

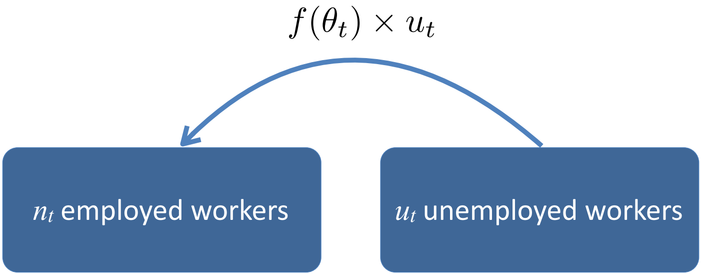
v vacancies

WORKER FLOWS: JOB CREATION & SEPARATION

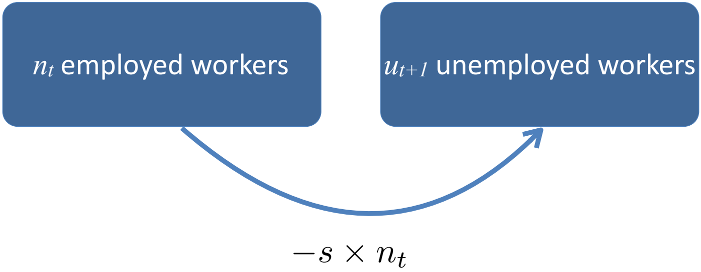
$1 - u_t$ employed workers

u_t unemployed workers

WORKER FLOWS: JOB CREATION & SEPARATION



WORKER FLOWS: JOB CREATION & SEPARATION



LABOR SUPPLY

- labor supply $\equiv$ workers' employment rate when labor market flows are balanced
- balanced flows: E $\rightarrow$ U = U $\rightarrow$ E
  - $s \cdot n = f(\theta) \cdot u = f(\theta) \cdot [1 - n + s \cdot n]$
- expression for labor supply:

$$n^s(\underset{+}{\theta}) = \frac{f(\theta)}{s + (1-s) \cdot f(\theta)}$$

  - equivalent to the Beveridge curve

REPRESENTATIVE FIRM

- hires $l_t - (1 - s) \cdot l_{t-1}$ new workers by posting vacancies
  - cost per vacancy: $r \cdot a$
  - vacancy-filling probability: $q(\theta_t)$
- employs l_t workers paid w
- production function: $y_t = a \cdot l_t^{\alpha}$
  - a: level of technology
  - $\alpha \in (0, 1]$: marginal returns to labor

FIRM'S PROBLEM

- given wage and tightness $\{w, \theta_t\}$, the firm chooses employment $\left\{l_t\right\}$ to maximize discounted profits

$$\sum_{t=0}^{+\infty} \beta^t \cdot \left[\underbrace{a \cdot l_t^{\alpha}}_{\text{production}} - \underbrace{w \cdot l_t}_{\text{wage bill}} - \underbrace{\frac{r \cdot a}{q(\theta_t)}}_{\text{hiring cost}} \cdot \underbrace{\left[l_t - (1-s) \cdot l_{t-1} \right]}_{\text{new hires}} \right]$$

PRIVATE LABOR DEMAND

- first-order condition with respect to l in steady state:

$$\underbrace{a \cdot \alpha \cdot l^{\alpha-1}}_{\text{marginal product of labor}} = \underbrace{w}_{\text{wage}} + \underbrace{\left[1 - \beta \cdot (1-s)\right] \cdot \frac{r \cdot a}{q(\theta)}}_{\text{recruiting cost}}$$

- given θ and w, the private labor demand is firms' desired employment rate in steady state:

$$l^d(\underline{\theta}, \underline{w}) = \left[\frac{1}{\alpha} \cdot \left\{\frac{w}{a} + \left[1 - \beta \cdot (1-s)\right] \cdot \frac{r}{q(\theta)}\right\}\right]^{\frac{-1}{1-\alpha}}$$

WAGE SCHEDULE

- there are mutual gains from matching
- many wage schedules are consistent with equilibrium
- we assume a simple wage schedule: $w = \omega \cdot a^{\gamma}$
  - $\gamma = 0$: fixed wage (unresponsive to a)
  - $\gamma = 1$: flexible wage (proportional to a)
  - $\gamma \in (0, 1)$: partially rigid wage (subproportional to a)

AGGREGATE LABOR DEMAND

- using the wage schedule, we rewrite the private labor demand as a function of θ and a:

$$l^d(\underset{-}{\theta}, \underset{+}{a}) = \left[\frac{1}{\alpha} \cdot \left\{\omega \cdot a^{\gamma-1} + \left[1 - \beta \cdot (1 - s)\right] \cdot \frac{r}{q(\theta)}\right\}\right]^{\frac{-1}{1-\alpha}}$$

- aggregate labor demand:

$$n^d(\underset{-}{\theta}, \underset{+}{a}, \underset{+}{g}) = l^d(\theta, a) + g$$

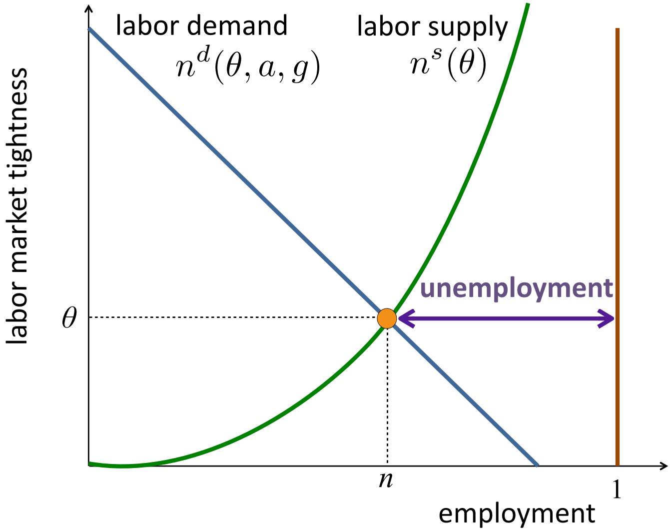
STEADY-STATE EQUILIBRIUM

- tightness equalizes labor supply and demand:

$$n^s(\underset{+}{\theta}) = n^d(\underset{-}{\theta}, \underset{+}{a}, \underset{+}{g})$$

- recession: low technology *a*
- expansion: high technology *a*
- stimulus: high public employment *g*
- note: in matching models, the convergence to steady state is almost immediate [Hall 2005]

EQUILIBRIUM DIAGRAM



PROPERTIES OF THE MULTIPLIER

DEFINITION OF THE MULTIPLIER

- the multiplier is $\lambda \equiv dn/dg$
  - additional number of employed workers when 1 worker is hired in the public sector
- another expression: $\lambda = 1 + dl/dg$
  - 1: mechanical effect of public employment
  - $dl/dg < 0$: crowding out of private employment by public employment
  - weaker crowding out $\Rightarrow$ larger multiplier

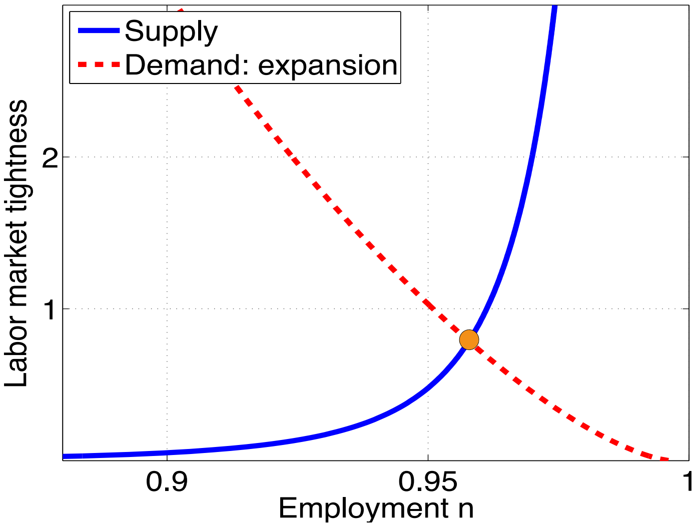
ASSUMPTIONS FROM MICHAILLAT [2012]

- $\alpha < 1$: diminishing marginal returns to labor in production
  - $\rightsquigarrow$ in (n, θ) plane: $n^d(\theta, a, g)$ is downward-sloping
- $\gamma < 1$: partial wage rigidity
  - $\rightsquigarrow$ in (n, θ) plane: $n^d(\theta, a, g)$ shifts inward when a rises

MULTIPLIER PROPERTIES WHEN $\alpha < 1$ AND $\gamma < 1$

- multiplier < 1
  - there is crowding out of private employment by public employment
- but multiplier > 0
  - crowding out is less than one-for-one
- multiplier is larger when a is lower
  - higher unemployment $\rightsquigarrow$ weaker crowding out $\rightsquigarrow$ larger multiplier

POSITIVE MULTIPLIER



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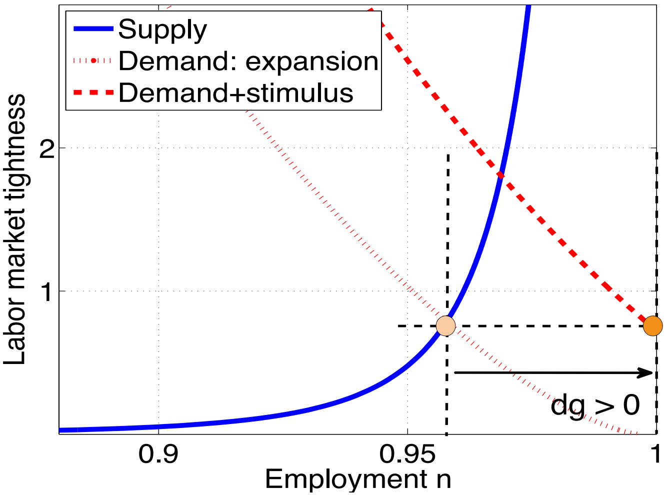

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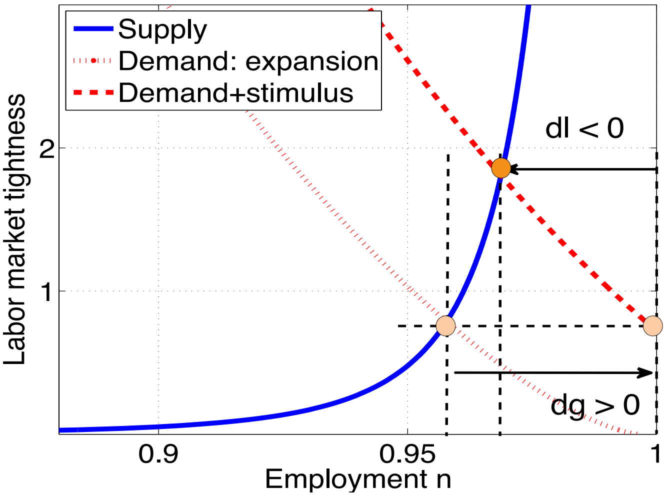

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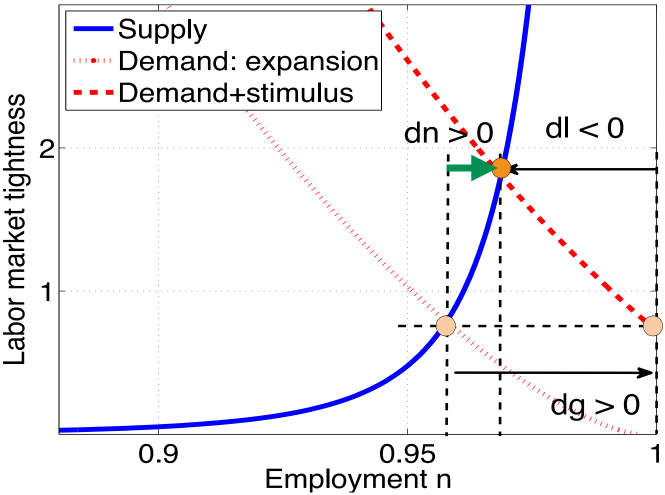
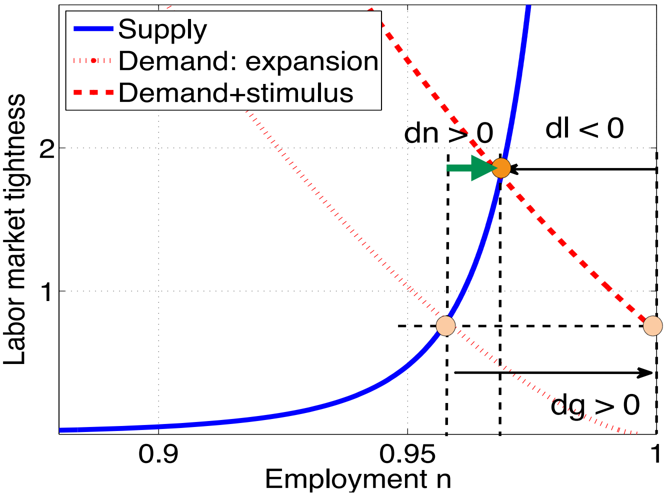


COUNTERCYCLICAL MULTIPLIER



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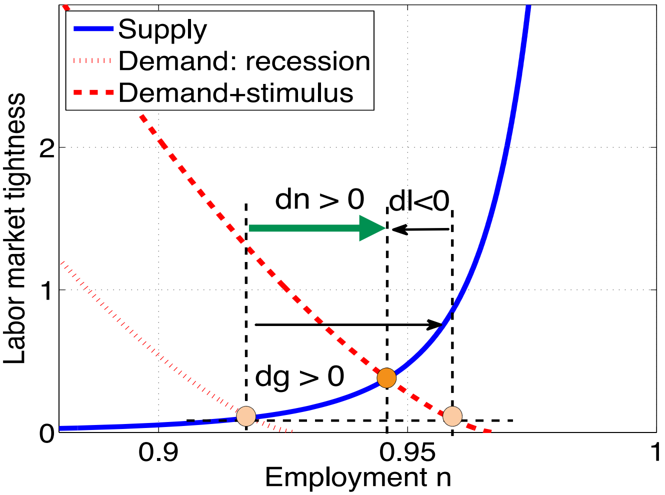


INTUITION FOR THE MECHANISM

- when unemployment is high:
  - government hires unemployed workers who would not have been hired otherwise
  - ⇝ public employment does not affect private employment much
- but when unemployment is low:
  - government hires workers that would have been hired by the private sector otherwise
  - ⇝ public employment heavily crowds out private employment

WHAT HAPPENS IF $\alpha = 1$?

- $\alpha = 1$: linear production function
  - standard assumption [Pissarides 2000; Hall 2005]
- in (n, θ) plane: labor demand is horizontal

$\rightsquigarrow$ a change in g does not change θ

$\rightsquigarrow$ crowding out is one-for-one

$\rightsquigarrow$ multiplier = 0

WHAT HAPPENS IF $\gamma = 1$?

- $\gamma = 1$: flexible wage
  - as with Nash bargaining
- in (n, θ) plane: labor demand is independent of a

$\rightsquigarrow$ θ is independent of a

$\rightsquigarrow$ crowding out is independent of a

$\rightsquigarrow$ multiplier is acyclical

NEW KEYNESIAN MODEL

STANDARD FEATURES

- fluctuations arise from technology shocks
- representative large household
  - works for intermediate-good firms
  - consumes final good
  - saves using nominal bonds
- representative final-good firm
  - uses intermediate goods as input
  - sells output on perfectly competitive market

STANDARD FEATURES

- intermediate-good firms
  - use labor as input
  - sell output on monopolistically competitive market to final-good firm
  - set price subject to a price-setting friction
- monetary policy
  - interest-rate rule (Taylor rule)

NONSTANDARD FEATURES

- labor market with matching structure from Michaillat [2012]
  - instead of perfect/monopolistic competition
- quadratic price-adjustment cost from Rotemberg [1982]
  - instead of Calvo [1983] pricing
- government consumption is public employment
  - instead of purchase of goods

9 ENDOGENOUS VARIABLES

- exogenous variables:

$$\{a_t, g_t\}_{t=0}^{+\infty}$$

- endogenous variables:

$$\left\{\theta_t, n_t, l_t, w_t, \Lambda_t, c_t, y_t, R_t, \pi_t\right\}_{t=0}^{+\infty}$$

LABOR MARKET EQUATIONS

- equation #1: wage schedule

$$w_t = \omega \cdot a_t^{\gamma}, \ \gamma < 1$$

- equation #2: labor supply

$$n_t = (1 - s) \cdot n_{t-1} + f(\theta_t) \cdot \left[1 - (1 - s) \cdot n_{t-1}\right]$$

- equation #3: public-employment policy

$$n_t = l_t + g_t$$

PRODUCTION EQUATIONS

- equation #4: production function

$$y_t = a_t \cdot l_t^{\alpha}, \;\; \alpha < 1$$

- equation #5: resource constraint

$$y_t - \frac{r \cdot a_t}{q(\theta_t)} \cdot \left[n_t - (1-s) \cdot n_{t-1}\right] = c_t \cdot \left[1 + \frac{\phi}{2} \cdot \pi_t^2\right]$$

BOND MARKET EQUATIONS

- equation #6: Euler equation

$$1 = \beta \cdot \mathbb{E}_t\left(\frac{R_t}{1+\pi_{t+1}} \cdot \frac{c_t}{c_{t+1}}\right)$$

- equation #7: Taylor rule

$$R_t = \frac{1}{\beta} \cdot (1+\pi_t)^{\mu_\pi \cdot (1-\mu_R)} \cdot (\beta \cdot R_{t-1})^{\mu_R}$$

FIRM EQUATIONS

- equation #8: optimal pricing decision

$$\pi_t \cdot (\pi_t + 1) = \frac{1}{\phi} \cdot \frac{y_t}{c_t} [\epsilon \cdot \Lambda_t - (\epsilon - 1)] + \beta \cdot \mathbb{E}_t(\pi_{t+1} \cdot (\pi_{t+1} + 1))$$

- equation #9: optimal employment decision

$$\Lambda_t \cdot \alpha \cdot l_t^{\alpha-1} = \frac{w_t}{a_t} + \frac{r}{q(\theta_t)} - \beta \cdot (1 - s) \cdot \mathbb{E}_t\left(\frac{c_t}{c_{t+1}} \cdot \frac{a_{t+1}}{a_t} \cdot \frac{r}{q(\theta_{t+1})}\right)$$

STEADY STATE (n, θ) WITH ZERO INFLATION

- equation #2: labor supply

$$n^s(\theta) = \frac{f(\theta)}{s + (1 - s) \cdot f(\theta)}$$

- equation #8: $\Lambda = (\epsilon - 1)/\epsilon$
- equation #1: $w = \omega \cdot a^\gamma$
- equation #9: firms' labor demand

$$\frac{\epsilon - 1}{\epsilon} \cdot \alpha \cdot \left[l^d(\theta, a)\right]^{\alpha - 1} = \omega \cdot a^{\gamma - 1} + (1 - \beta \cdot (1 - s)) \cdot \frac{r}{q(\theta)}$$

SIMULATIONS

SIMULATION METHOD

- simulate nonlinear model under perfect foresight using shooting algorithm
- scenario #1: public employment without stimulus
  - value of g: $\hat{g}_t = \overline{g}$
  - value of any x: $\hat{x}_t$
  - solid blue lines in graphs
- scenario #2: public employment with stimulus
  - value of g: $g_t^* > \overline{g}$
  - value of any x: x_t^*
  - dashed red lines in graphs

COMPUTATION OF THE MULTIPLIER

- instantaneous multiplier in a simulation:

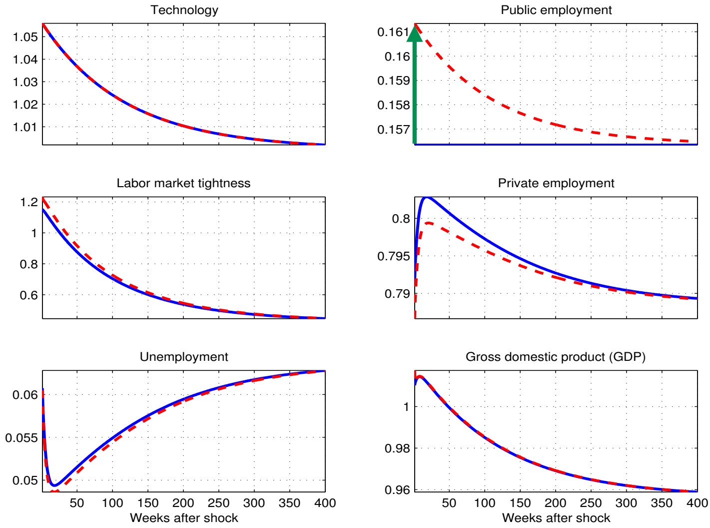
$$\frac{n_t^* - \hat{n}_t}{g_t^* - \hat{g}_t}$$

- cumulative multiplier in a simulation:

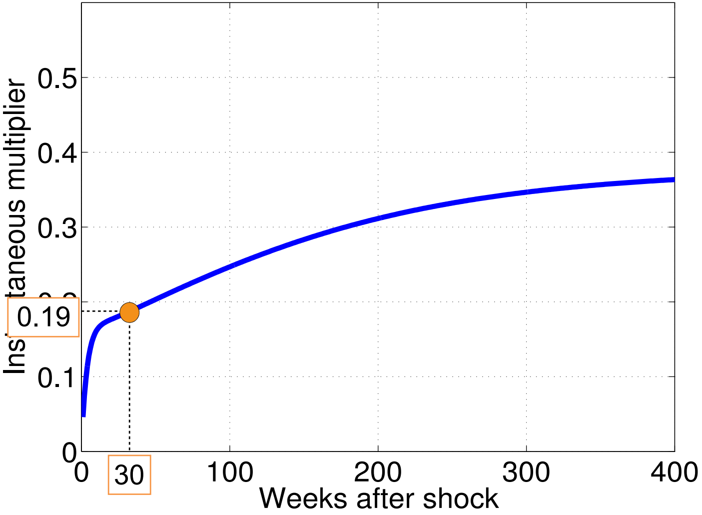
$$\frac{\sum_{t=0}^{T} n_t^* - \hat{n}_t}{\sum_{t=0}^{T} g_t^* - \hat{g}_t}$$

- cumulative multipliers are parametrized by the peak of the unemployment rate in the simulation

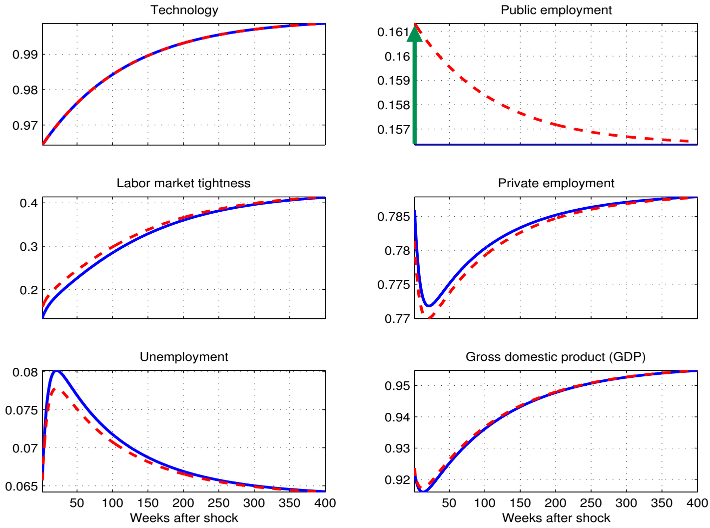
RESPONSE TO POSITIVE TECHNOLOGY SHOCK



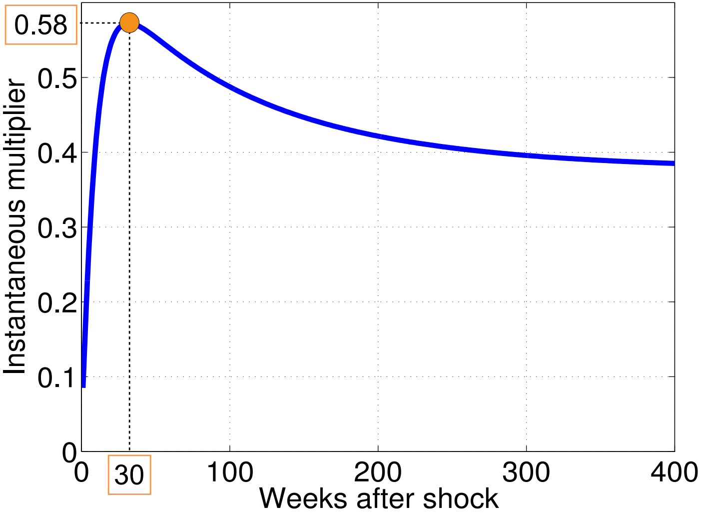
MULTIPLIER AFTER POSITIVE SHOCK



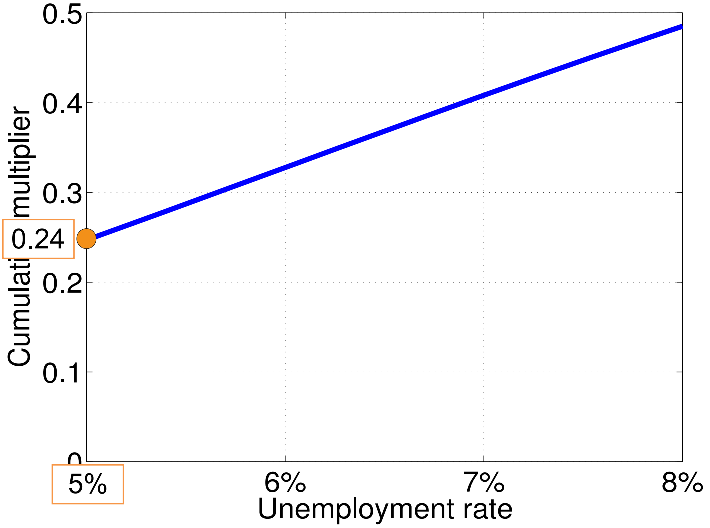
RESPONSE TO NEGATIVE TECHNOLOGY SHOCK



MULTIPLIER AFTER NEGATIVE SHOCK



COUNTERCYCLICAL CUMULATIVE MULTIPLIER



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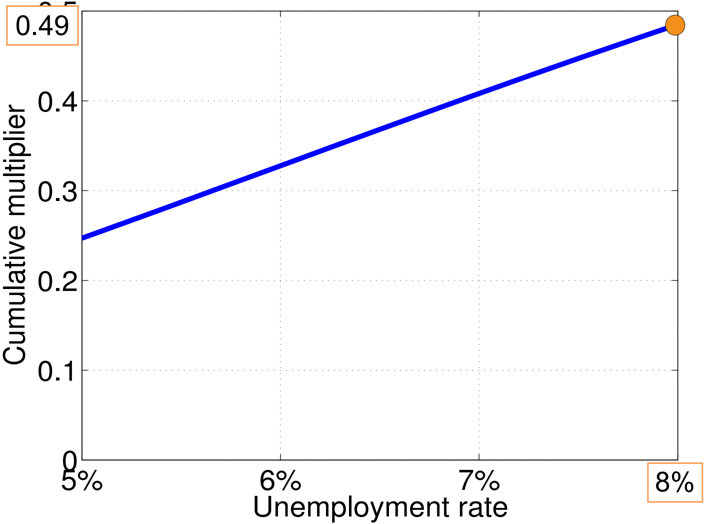

CONCLUSION

SUMMARY

- this paper proposes a New Keynesian model in which the government multiplier doubles when unemployment rises from 5% to 8%
- mechanism behind countercyclical multiplier:
  - multiplier = 1– crowding out
  - crowding out of private employment by public employment is much weaker when unemployment is higher

APPLICATIONS

- the same mechanism explains the procyclicality of the macroelasticity of unemployment with respect to unemployment insurance
  - see Landais, Michaillat, & Saez [2018]
- the same mechanism applies to the product market
  - see Michaillat & Saez [2019]
- the multiplier determines optimal stimulus spending
  - see Michaillat & Saez [2019]